REMARKS

1. The Patent Office stated that the Applicant has not complied with the requirements of 37 CFR 1.63(c) with regarding claiming priority from a foreign (German) application (page 2, item 1). Applicant respectfully point out the following quotation from rule 1.63(c) (emphasis added):

(c) **Unless such information is supplied on an application data sheet** in accordance with §1.76, the oath or declaration must also identify:

(1) [...]

(2) Any foreign application for patent (or inventor's certificate) for which a claim for priority is made pursuant to § 1.55, [...].

Rule 1.63 (c) says that a priority claim to a foreign application is properly made either on the application data sheet or in the declaration. Applicant filed the application data sheet with a proper propriety claim to German application DE 101 07 095.0 and its filing date of February 14, 2001, to the Patent Office on February 6, 2002, the filing date of the present application. A copy of the application data sheet containing the proper priority claim is enclosed to this response. Therefore, no new declaration is necessary for this case.

2. Applicant respectfully objects to item 2 of the Office Action regarding Oath/Declaration and respectfully asserts that the submitted Declaration is not defective under 37 CFR 1.76 and MPEP 602.01 and 602.02. According to MPEP 602.01, an oath or declaration is defective it is has been altered in any manner after it has been signed by an inventor. In the present case the third inventor, Dr. Stefan Hell, during the signing of the declaration, started to write the date in the European fashion (date/month/year, as it is customary in Europe). Half way through writing the date, he recalled that in the U.S. it is customary to write the date as month/date/year, crossed out the European-style date and wrote the U.S.-style date, which is exactly the same date written by exactly the same inventor at the time when he signed the Declaration. Therefore the present Declaration does not violate the requirements of a valid Declaration. Under the same section 602.01, a new Declaration is required if the wording of the Declaration is incorrect, or the required affirmations have not been made or if the Declaration had not been properly subscribed

to. The way of writing the date in a European or an American manner pertains neither to the working of the Declaration nor to the required affirmation nor to the subscription and, therefore, does not render the Declaration defective within the meaning of MPEP 602.01 and 602.01. Moreover, 37 CFR 1.76 states that the required applicant's information includes the name, residence, mailing address, and citizenship of each applicant. The name of each applicant must include the family name, and at least one given name without abbreviation together with any other given name or initial. As follows from this section, the custom in which the date written is not relevant for the Declaration at all. Applicant respectfully requests withdrawal of the objection to the Declaration.

3. With regard to item 5 of the Office Action, Applicant submits an amended specification in which most of the description previously contained in the SUMMARY OF THE INVENTION section has been moved to the DETAILED DESCRIPTION FO THE INVENTION section. In order to reduce the length of this response, Applicant respectfully asks the Examiner to kindly amend line 8 on page 10 to read -390- instead of "290" as an Examiner's amendment in compliance with item 6 on page 3 of the Office Action.

4. Claims 2 and 7 are cancelled. Claims 17 – 35 have been added. Claims 1, 3-6 and 8-16 were amended. It is believed that the amended Claims and the newly introduced claims overcome the indefiniteness rejection under 35 USC 112 (second paragraph) articulated in item 10 on page 4 on the Office Action.

5. The Patent Office rejected Claims 1-16 under 35 USC 112 (first paragraph) as insufficient to enable one skilled in the art to make the device without undue experimentation. Applicant respectfully asserts that the Claims as amended and as added comply with the requirement of 35 USC 112 (first paragraph). In particular, it is respectfully pointed out that in accordance with an exemplary embodiment shown in FIG. 1, optical element 24 may be used to modify the illumination point spread function (PSF) by varying the amplitude, phase or polarization of the light in illumination beam path 1. Similarly, optical element 25 may be used to modify the detection point spread function (PSF) by varying the amplitude, phase or polarization of the light in the detection beam path. It should be noted that the PSF of a beam

path is responsive, at least in part, to the amplitude, phase or polarization of the light in a beam path, which is a well known concept. As such, by varying the amplitude, phase and/or polarization of the light in a beam path using optical element 24 and/or optical element 25, the distance between a principal maximum of the illumination PSF in illumination beam path 1 and a secondary maxima or the distance between a principal maximum of the point detection PSF in the detection beam and a secondary maxima may be increased. Additionally, by varying the amplitude, phase and/or polarization of the light in a beam path using optical element 24 and/or optical element 25, the intensity of the secondary maxima of the illumination PSF in the illuminating beam path or the intensity of the secondary maxima of the detection PSF in the detection beam path may be reduced. In light of the above, optical element 24 and/or optical element 25 are be selected and calibrated in a manner suitable to achieve the intended purpose of the invention.

In particular, optical element 24 and/or optical element 25 may be selected, disposed and calibrated to locate the secondary maxima of the illumination PSF in illuminating beam path 1 or the detection PSF in the detection beam path at different axial positions. As specified in the description of the invention, optical element 24 and/or optical element 25 may be selected, disposed and calibrated to modulate the wave front of the illuminating light or the detection light. In accordance with an exemplary embodiment, optical element 24 and/or optical element 25 may be an amplitude filter and/or a phase filter, a retardation plate or a phase plate, which are well known optical elements. The use of a filter or a plate in two described optical elements (24 and 25) can not be deemed to be undue experimentation for one skilled in the art. In addition, optical element 24 and/or optical element 25 may include an LCD (liquid crystal device) arrangement or may be configured as partially amplitude-modifying elements. Furthermore, optical element 24 and/or optical element 25 may be configured as an adaptive optical system comprising a deformable mirror or may be embodied as a dichroic filter that is disposed in the illuminating beam path or the detection beam path. These are all well known optical elements with well-known functionality. It is undoubtedly true that one skilled in the art will know which element should be used for which purpose without undue experimentation. Therefore, Applicant respectfully requests that the above-referenced rejection be withdrawn and the Claims as amended and added be allowed.

6. The Patent Office rejected Claims 1, 7-12, 14 and 16 under 35 USC 102(e) as anticipated by Nagano et al. (U.S.Patent No. 6,025,956, "Nagano"). Applicant respectfully asserts that Claims 1, 8-12, 14 and 16 as amended overcome the rejection. In particular, Applicant's attorney studied the Nagano patent and could not find there the disclosure of a double confocal scanning microscope with two microscope objectives for focusing light of the illumination beam path onto a specimen disposed in a common specimen plane, which is defined by the two microscope objectives, and an optical component for modifying the point spread function of the light in the illuminating beam path or the detection beam path, as particularly claimed in the above-reference amended Claims. Therefore, withdrawal of this rejection and allowance of the Claims is respectfully requested.

7. Claims 1-8, 10-12, 14 and 16 were rejected under 35 USC 102(b) as being anticipated by Dixon (U.S. Patent No. 5,386,112, "Dixon"). Applicant respectfully asserts that the Claims as amended are not anticipated by Dixon. In particular, no disclosure of a double confocal scanning microscope having two microscope objectives for focusing light of the illumination beam path onto a specimen in a common specimen plane (defined by the two microscope objectives) and an optical component for modifying the point spread function of the light in the illuminating beam path or the point spread function in the detection beam path could be found in Dixon. Moreover, Dixon does not disclose a double confocal microscope, because the path length of the illuminating light is identical for both lenses or microscope objectives, which is an important feature of a double confocal microscope, could not be found in Dixon. Therefore, the above-referenced amended Claims are not anticipated by Dixon. Allowance of the Claims is respectfully requested.

8. Claims 1-8, 10-12, 14 and 16 were rejected under 35 USC 102(b) as being anticipated by Gustafsson (U.S. Patent No. 5,671,085, "Gustafsson"). Applicant respectfully asserts that the Claims as amended now are not anticipated by Gustafsson. In particular, Applicant's attorney could not find an optical component for modifying the point spread function of the light in the illuminating beam path or the detection beam path disclosed in that patent. Therefore, the above-referenced amended Claims are not anticipated by Gustafsson. Allowance of the Claims is respectfully requested.

9. Claims 1-8, 10, and 13-16 were rejected under 35 USC 102(b) as being anticipated by Krause (U.S. Patent No. 5,587,832, "Krause"). Referring to the above-referenced Claims as amended, Applicant's attorney points out that nowhere in that patent could be found a disclosure to a double confocal scanning microscope having two microscope objectives for focusing light of the illumination beam path onto a specimen which in a common specimen plane defined by the two microscope objectives, and an optical component for the for modifying the point spread function of the light in the illuminating beam path or the detection beam path. To the contrary, the aperture array 14 as disclosed by Krause is used to transform the illumination light from a light source 18 into pattern of illumination spots which are imaged on the specimen 20 (col 3, line 63 to col. 4, line 2). Therefore, the Claims as amended are not anticipated by Krause. Allowance of the Claims is respectfully requested.

CONCLUSION

In accordance with 37 CFR 1.21 (c)(1)(ii) a marked up version of the amendment claims is attached as Appendix A. For the foregoing reasons, Applicant believes this application is in condition for allowance which is respectfully requested. If a fee is due with this amendment for additional claims, please charge it to our deposit account 500369.

Respectfully submitted,

Maria Eliseeva

Maria Eliseeva
Reg. No. 43,328
Brown Rudnick Berlack Israels LLP
Box IP,
One Financial Center
Boston, MA 02111
Phone: 617-856-8340
Fax: 617-856-8201
e-mail: meliseeva@brbilaw.com

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APPENDIX A

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the specification:

Summary of the Invention

Please delete paragraphs [0013] – [0024].

Paragraphs [0011] and [0012] have been amended as follows:

What is advantageous [has been recognized] according to the present invention is firstly that a modification of the characteristics of the double confocal illumination, the detected contributions that result from the secondary maxima can be greatly reduced if not indeed eliminated. A modification of the detection characteristics or of the illumination and detection characteristics can also result in a diminution of the detected contributions from the secondary maxima. As a result of a diminution in the secondary maxima, the reconstruction methods can be successfully applied and ideally can even be dispensed with.

[According to the present invention, therefore] Therefore, at least one optical component is arranged in the beam path of the double confocal scanning microscope; the optical component can be provided in either the illuminating beam path or the detection beam path, or in the illuminating and detection beam paths. If an optical component is arranged only in the illuminating beam path, only the characteristics of the double confocal illumination are thereby modified. Arranging the optical component only in the detection beam path correspondingly modifies the characteristics of the double confocal detection. Arranging the optical component in the illuminating and detection beam paths affects the characteristics of the double confocal illumination and detection. The optical component is configured in such a way that it influences the amplitude and/or phase and/or polarization of the light, specifically of the light that interacts with the optical component. The interaction is understood to be, for example, a transmission, a reflection, or a combination of transmission and reflection (for example in the case of an optical component of partially reflective configuration).

Detailed Description of the Invention

Paragraph [0038] has been amended as follows:

FIG. 3 shows, in a diagram, the normalized intensity of the illumination PSF of the double confocal scanning microscope of FIG. 1, but without the use of the two optical components 24, 25. The diagram shows the normalized intensity of the illuminating light as a function of the local coordinate along optical axis 27 (drawn with dashed lines in FIG. 1) in the focus region of the two microscope objectives 18, 19. The principal maximum of the illumination PSF, which has a normalized intensity value of 1, is visible at the Z coordinate 300. The first two secondary maxima, which have normalized intensity values of approximately 0.5, are visible to the left and right of the principal maximum. The shape of the double confocal illumination PSF and/or detection PSF can be modified by the optical component 24 or 25. Provision is made in this context, in particular, for the shape of the axially arranged secondary maxima of the double confocal illumination PSF and/or detection PSF to be modified in controlled fashion; modification of the principal maximum is also conceivable. In the event that operation of the double confocal scanning microscope is directed toward the presence of destructive interference, the optical component 24 or 25 could also modify the shape of the two principal maxima resulting from the destructive interference. In particularly preferred fashion, the optical component is configured in such a way that by means of its utilization, the intensity of the secondary maxima of the illumination PSF and/or detection PSF can be diminished. As a result, in particularly advantageous fashion, the detected contributions brought about by the secondary maxima of the illumination PSF and/or detection PSF can be similarly diminished.

Please add the following paragraphs after paragraph [0045] in the "Detailed Description of the Invention" section:

In very particularly preferred fashion, provision is made for the secondary maxima of the illumination PSF and the detection PSF to be located, as a result of the optical component 24 and 25 , at different positions. Because, in double confocal scanning microscopy as in confocal scanning microscopy, the overall PSF is defined by the product of the illumination PSF and the detection PSF, the intensity of the secondary maxima of the overall PSF can be reduced or minimized by the fact that the principal maxima of the illumination PSF and detection PSF are located in the same position, but the secondary maxima of the illumination PSF and detection PSF are located at different positions. Creation of the product thus causes only the principal maximum, but not the secondary maxima, to exhibit a high intensity value. Since the secondary maxima are arranged, in double confocal scanning microscopy, in particular along the optical axis (i.e. in the axial direction), the secondary maxima of the illumination PSF and detection PSF can be diminished in intensity if, in particular, the secondary maxima are located at different axial positions.

In a particularly preferred embodiment, several optical components 24 and 25 (see Fig. 1 and 2) are provided for influencing the amplitude and/or phase and/or polarization of the light. For example, the optical component 24 and 25 arranged in the one beam path segment 14 of the double confocal scanning microscope could be different from that in the other beam path segment 15. Furthermore, an optical component different from that in the illuminating beam path 1 could be provided in the detection beam path 3. Lastly, in such cases the optical components are to be configured in such a way that the characteristics of the double confocal illumination and/or detection are optimized in terms of signal yield and minimization of image artifacts.

In order to modify the characteristics of the double confocal illumination and/or detection, provision is made for the optical component to modulate the wave front of the illuminating light and/or the detected light. This can be a temporal and/or spatial modulation, although a spatial modulation is preferred. It would be conceivable, for example, when two optical components are used, for the spatial modulation of the light brought about by the components to be variable over time. In particular, provision could then be made for a specimen to be imaged twice with the double confocal scanning microscope according to the present invention, the modulation of the two optical components being configured exactly oppositely in each case for the second specimen detection, so that an optimum specimen data set can be extracted computationally from the two detected specimen data sets.

In particularly preferred fashion, the optical component 24, 25 is arranged in a microscope objective pupil. Because of the poor accessibility of the pupil plane of a microscope objective, which generally is located in the objective itself, a plane optically conjugated with the pupil plane is preferably selected as the filter location. With such an arrangement, the design and configuration of the optical components can more easily be calculated. The reason for this is that if the optical components influencing the light are arranged in the microscope objective pupil or in a plane optically conjugated therewith, it is possible to utilize the methods of Fourier optics. Of course it is also possible to arrange the optical component at any desired location in the illuminating and/or detection beam path, but in such a case a possibly more complex calculation of the optical component is necessary.

Concretely, an amplitude filter and/or phase filter could be provided as the optical component 24, 25. Said filter correspondingly influences the amplitude and/or phase of the light. Provision is

made for the filter to exhibit different amplitude or phase properties perpendicular to the optical axis. Retardation plates and/or phase plates can furthermore serve as optical components.

An LCD (liquid crystal device) arrangement could be provided as the optical component. The use of LCD arrangements makes possible, in particularly advantageous fashion, a flexible and variable configuration of the optical component. If a color LCD arrangement is used, light of individual wavelengths or individual wavelength regions can, in particularly advantageous fashion, be selectively influenced.

Partially amplitude-modifying elements can furthermore serve as optical components. This can be, in particular, a neutral density filter that exhibits locally different filter properties.

It is conceivable in very general terms for other elements that modify the wave front of the illuminating or detected light to be provided as the optical component. For example, it may be mentioned at this juncture that an adaptive optical system could be provided as the optical component. This could be, concretely, a deformable mirror. The deformable mirror could, for example, be configured in such a way that piezoelements which can individually be differently activated are arranged between a deformable mirror layer and a baseplate. The mirror surface can thus be deformed as a function of the activation of the individual piezoelements.

Provision is also made for the optical component to have different effects on light of differing polarization and/or wavelengths. For example, the optical component could have – in addition to its properties modifying the amplitude, phase, and/or polarization – an at least locally reflective effect on light of a specific polarization direction. The optical component could, again at least locally, influence the polarization of the light in such a way that light of one polarization state is converted to another. This could involve a simple rotation of the polarization direction of the

light; a conversion from a circular to an elliptical or linear polarization, and vice versa, is also conceivable. The optical component could, however, also be embodied as a dichroic filter, so that its filter effect acts only on light of a specific wavelength region.

In the claims:

Claims 2 and 7 have been canceled.
Claims 17 – 35 have been added.
Claims 1, 3-6 and 8-6 have been amended as follows:

1. (Amended) A double confocal scanning microscope comprising:
   - at least one [a] light source defining an illuminating beam path with an inherent illumination point spread function (PSF);
   - a detector defining a detection beam path with an inherent detection point spread function (PSF);
   - two microscope objectives for focusing light of the illumination beam path onto a specimen which is disposed in a common specimen plane defined by the two microscope objectives;
   - at least one optical component [acting on] arranged in the illuminating [and/]or detection beam path, wherein the optical component is configured [that it influences] to vary the amplitude, phase or polarization of the light; and thereby to modify the [characteristics] illumination PSF of the light in the illuminating beam path or the detection PSF in the detection beam path of the double confocal scanning microscope. [is are thereby modifiable].

3. (Amended) The double confocal scanning microscope as defined in Claim 1 [2], wherein the [point spread function] illumination (PSF) in the illumination beam path and the detection PSF in the detection beam path shows axially arranged secondary maxima both of which are modifiable as to their shape [and/] or position.

4. (Amended) The double confocal scanning microscope as defined in Claim 1 [3], wherein the optical component is used to increase the distance between a principal maximum of the [point spread function] illumination (PSF) in the illumination beam path or [and] a principal maximum of the [point spread function] detection (PSF) in the detection beam and secondary maxima.

5. (Amended) The double confocal scanning microscope as defined in Claim 1 [3], wherein the optical component is used to [diminish] reduce the intensity of the secondary maxima of the [point spread function] illumination (PSF) in the illuminating beam path or [and] the [point spread function] detection (PSF) in the detection beam path.

6. (Amended) The double confocal scanning microscope as defined in Claim 1 [3], wherein the optical component is used to locate the secondary maxima of the [point spread function] illumination (PSF) in the illuminating beam path or [and] the [point spread function] detection (PSF) in the detection beam path at different[, preferably] axial [,] positions.

8. (Amended) The double confocal scanning microscope as defined in Claim 1, wherein the optical component modulates the wave front of the illuminating light or detection light.

9. (Amended) The double confocal scanning microscope as defined in Claim[s] 1, wherein the optical component is [arranged] disposed in a [microscope objective] pupil of at least one microscope objective or in a plane optically conjugated therewith.

10. (Amended) The double confocal scanning microscope as defined in Claim 1, wherein the optical component is [arranged] disposed at any desired location in the illuminating beam path [and/] or detection beam path.

11. (Amended) The double confocal scanning microscope as defined in Claim 1, wherein the optical component is an amplitude filter and [/or] phase filter.

12. (Amended) The double confocal scanning microscope as defined in Claim 1, wherein the optical component is a retardation plate [and/] or phase plate.

13. (Amended) The double confocal scanning microscope as defined in Claim 1, wherein the optical component is an LCD (liquid crystal device) arrangement.

14. (Amended) The double confocal scanning microscope as defined in Claim 1, wherein the optical component is configured as partially amplitude-modifying elements.

15. (Amended) The double confocal scanning microscope as defined in Claim 1, wherein the optical component is configured as an adaptive optical system, preferably in the form of a deformable mirror.

16. (Amended) The double confocal scanning microscope as defined in Claim 1, wherein the optical component is embodied as a dichroic filter that preferably is arranged in the illuminating beam path or [and] detection beam path.

17.(New) The double confocal scanning microscope as defined in Claim 1, wherein the illumination PSF in the illumination beam path and the detection PSF in the detection beam path shows axially arranged secondary maxima both of which are modifiable as to their shape and position.

18.(New) The double confocal scanning microscope as defined in Claim 1, wherein the optical component is an amplitude filter or a phase filter.

19.(New) A double confocal scanning microscope comprising:

- at least two light sources each of which defining an illuminating beam path with an inherent illumination point spread function (PSF);
- a detector defining a detection beam path with an inherent detection point spread function (PSF),
- two microscope objectives for focusing light of the illumination beam path onto a specimen which is disposed in a common specimen plane defined by the two microscope objectives; and
- at least one optical component arranged in one of the illuminating beam paths and the detection beam path, wherein the optical component is configured to vary the amplitude, phase or polarization of the light, and thereby to modify the illumination PSF of the light in the illuminating beam path and the detection PSF in the detection beam path of the double confocal scanning microscope.

20. (New) The double confocal scanning microscope as defined in Claim 19, wherein the illumination PSF in the illumination beam path and the detection PSF is in the detection beam path show axially arranged secondary maxima both of which are modifiable as to their shape or position.

21. (New) The double confocal scanning microscope as defined in Claim 19, wherein the illumination PSF in the illumination beam path and the detection PSF in the detection PSF in the detection beam path show axially arranged secondary maxima both of which are modifiable as to their shape and position.

22. (New) The double confocal scanning microscope as defined in Claim 3, wherein the optical component is used to increase the distance between a principal maximum of the illumination PSF in the illumination beam path and a principal maximum of the detection PSF in the detection beam and secondary maxima.

23. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component is used to diminish the intensity of the secondary maxima of the illumination PSF in the illuminating beam path and the detection PSF in the detection beam path.

24. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component is used to locate the secondary maxima of the illumination PSF in the illuminating beam path and the detection PSF in the detection beam path at positions comprising axial positions.

25. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component provided in the illuminating beam path is different from that provided in the detection beam path.

26. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component modulates the wave front of the illuminating light and detection light.

27. (New) The double confocal scanning microscope as defined in Claims 19, wherein the optical component is disposed in a pupil of at least one microscope objective or in a plane optically conjugated therewith.

28. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component is disposed at any desired location in the illuminating beam path and/or detection beam path.

29. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component is an amplitude filter or phase filter.

30. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component is an amplitude filter and phase filter.

31. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component is a retardation plate and phase plate.

32. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component is a retardation plate or phase plate.

33. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component is an LCD (liquid crystal device) arrangement.

34. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component is configured as partially amplitude-modifying elements.

35. (New) The double confocal scanning microscope as defined in Claim 19, wherein the optical component is configured as an adaptive optical system comprising a deformable mirror.